

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES**

In Re Application of:)	
)	
Chen, et al.)	Confirmation No.: 9818
)	
Serial No.: 10/810,965)	Examiner: Trinh, Hoa B.
)	
Filed: March 26, 2004)	Group Art Unit: 2814
)	
For: Novel Method to Improve Bump Reliability for)	TKHR Docket: 252016-2530
Flip Chip Device)	Top-Team: 0503-A30731US

SUBSTITUTE APPEAL BRIEF UNDER 37 C.F.R. §1.192
IN RESPONSE TO NOTIFICATION OF NON-COMPLIANT APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner of Patents and Trademarks
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

This substitute brief is filed in response to the Notification of Non-Compliant Appeal Brief, mailed from the PTO on 12-1-06. Specifically, that notification stated that claims 37 and 38 were not mapped to the specification by page and line number, paragraph number, or to the drawings, if any. This substitute brief makes the appropriate correction in the summary of the claimed subject matter section. In all other respect, this substitute brief is the same as the original appeal brief. The undersigned notes, however, that since independent claims 37 and 38 are not being separately argued from independent claim 29, that the separate summaries of these claims should not be required. They are nonetheless provided herein to advance the prosecution of this appeal.

This is an appeal from the decision of Hoa B. Trinh, Group Art Unit 2814, mailed April 24, 2006, rejecting all claims 29-34 and 36-38 in the present application and making the rejection FINAL.

I. REAL PARTY IN INTEREST

The real party in interest of the instant application is Taiwan Semiconductor Manufacturing Company, Ltd., having its principal place of business at 8 Li-Hsin Rd. 6, Hsinchu Science Park, Hsinchu, Taiwan 300-77, R.O.C..

II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

III. STATUS OF THE CLAIMS

The FINAL Office Action has rejected all claims 29-34 and 36-38, and Applicant hereby appeals the rejection as to all claims.

IV. STATUS OF AMENDMENTS

No amendments have been made since the mailing date of the FINAL Office Action, and all amendments made previously have been entered. Attached hereto as Appendix A is a listing of the claims in their current form.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Embodiments of the claimed subject matter are illustrated in FIGs. 5 through 12 and are discussed in the specification at least at pages 13-23.

Embodiments of the invention, such as that of claim 29, define a solder bump for interconnection of flip chip devices. The solder bump comprises a semiconductor surface (see

e.g., FIGs. 5-12, reference number 10, and related description) and at least one contact pad (see e.g., FIGs. 5-12, reference number 14, and related description) over said semiconductor surface (see e.g., FIGs. 5-12, reference number 10, and related description). A passivation layer (see e.g., FIGs. 5-12, reference number 12, and related description) is provided over said semiconductor surface, said passivation layer (see e.g., FIGs. 5-12, reference number 12, and related description) exposing said at least one contact pad (see e.g., FIGs. 5-12, reference number 14, and related description). An Under-Bump-Metallurgy (UBM) layer (see e.g., FIGs. 5-12, reference number 18, and related description) is provided over said layer of passivation (see e.g., FIGs. 5-12, reference number 12, and related description) and said at least one contact pad (see e.g., FIGs. 5-12, reference number 14, and related description), lateral dimension of the UBM layer (see e.g., FIGs. 5-12, reference number 18, and related description) being limited to be within lateral dimension of the at least one contact pad. Finally, at least one solder compound (see e.g., FIGs. 9-12, reference number 41, and related description) is provided overlying the UBM layer (see e.g., FIGs. 5-12, reference number 18, and related description), wherein the solder compound comprises a flat top surface, a flat bottom surface and convex sidewalls (see e.g., FIG. 12, reference number 14, and related description), and the flat top surface is greater than the flat bottom surface before connecting to other components (clearly illustrated in FIG. 12).

Embodiments of the invention, such as that of claim 37, define a solder bump for interconnection of flip chip devices. In one embodiment, the solder bump comprises a semiconductor surface (see e.g., Fig. 12, **reference number 10** and related description); at least one contact pad over said semiconductor surface (see e.g., Fig. 12, **reference number 14** and

related description); a passivation layer over said semiconductor surface, said passivation layer exposing said at least one contact pad (see e.g., Fig. 12, *reference number 12* and related description); an Under-Bump-Metallurgy (UBM) layer over said passivation layer and said at least one contact pad, lateral dimension of the UBM layer being limited to a size approximately the same as lateral dimension of the at least one contact pad (see e.g., Fig. 12, *reference number 18* and related description); and at least one solder compound overlying the UBM layer, wherein the solder compound comprises a flat top surface, a flat bottom surface and convex sidewalls, and the flat top surface is greater than the flat bottom surface before connecting to other components (see e.g., Fig. 12, *reference number 41* and related description).

Embodiments of the invention, such as that of claim 38, define a solder bump for interconnection of flip chip devices. In one embodiment, the solder bump comprises a semiconductor surface (see e.g., Fig. 12, *reference number 10* and related description); at least one contact pad over said semiconductor surface (see e.g., Fig. 12, *reference number 14* and related description); a passivation layer over said semiconductor surface, said passivation layer exposing said at least one contact pad (see e.g., Fig. 12, *reference number 12* and related description); an Under-Bump-Metallurgy (UBM) layer over said passivation layer and said at least one contact pad (see e.g., Fig. 12, *reference number 18* and related description); and at least one solder compound overlying the UBM layer, wherein the solder compound comprises a flat top surface, a flat bottom surface and convex sidewalls, and the flat top surface is greater than the flat bottom surface before connecting to other components (see e.g., Fig. 12, *reference number 41* and related description).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 29, 31, 37-38 stand rejected under 35 U.S.C 102(b) as allegedly anticipated by or, in the alternative, under 35 U.S.C 103 (a) as obvious over Marrs (5,795,818).

The Office Action rejected claims 30, 32-34, and 36 under 35 U.S.C. 103(a) as allegedly unpatentable over Marrs (5,795,818) in view of Beddingfield (5,977,632).

VII. ARGUMENT

Fundamental Basis for Overturning the Rejections of All Claims

There is at least one fundamental basis for overturning the rejections as to all claims. As will be set forth in more detail below, each of the independent claims embodies the limitation of ***“at least one solder compound overlying the UBM layer.”*** The Advisory Action dismissively disregarded this argument stating: “on page 6 if the remarks, last paragraph, applicants quote Marrs in stating that ‘there is a need for applying solder...’ Clearly, there appears to a contradictory.” (*Sic*).

The last paragraph of Marrs, quoted in the last paragraph of p. 6 does not state what the Examiner alleges at all. In fact, it teaches just the opposite. In this regard, that paragraph states that “there is **NO** need for applying solder flux ...” (*Emphasis added.*) This comment is made immediately following a description of disadvantage of a prior art patent, in which Marrs states “This is a significant advantage over my U.S. Pat. No. 5,478,007 in which solder forms part of the electrical interconnection between the chip and substrate.” Thus, it is the prior art patent that discloses a solder interconnection. However, that patent doesn’t disclose the other features of the presently claimed invention. Likewise, the embodiments of the Marrs patent do not disclose the

claimed solder compound overlying the UBM layer. For at least this reason, the teachings of Marrs have been fundamentally misplaced and should be overturned.

Discussion of Rejections Under 35 U.S.C. 102(b) & 35 U.S.C. 103(a)

Claims 29, 31, 37-38 stand rejected under 35 U.S.C 102(b) as allegedly anticipated by or, in the alternative, under 35 U.S.C 103 (a) as obvious over Marrs (5,795,818). Applicant respectfully traverses the rejections made by the Examiner for at least the reasons discussed below.

Marrs discloses an integrated circuit chip to substrate interconnection and method. Specifically, referring to col. 10, lines 14-17, and Figs. 7, 8, Marrs teaches that the resulting bond 801 is a direct gold to gold connection between coined ball bond bump 312 on chip 201 and metallization 502 on substrate bonding contact 501C on substrate 501. In this teaching, it is taught or suggested to those skilled in the art that the coined ball bond bump 312 is gold. Moreover, referring to col. 10, lines 20-31 of Marrs, the passage “the resulting weld is not as susceptible to melting as solder” teaches or suggests that the coined ball bond bump 312 is NOT made by solder.

In contrast, each of the presently pending independent claims defines over these teachings. Specifically, independent claims 29 and 37-38 recite:

29. A solder bump for interconnection of flip chip devices comprising:
a semiconductor surface;
at least one contact pad over said semiconductor surface;
a passivation layer over said semiconductor surface, said passivation layer exposing said at least one contact pad;
an Under-Bump-Metallurgy (UBM) layer over said layer of passivation and said at least one contact pad, lateral dimension of the UBM layer being limited to be within lateral dimension of the at least one contact pad; and

at least one solder compound overlying the UBM layer, wherein the solder compound comprises a flat top surface, a flat bottom surface and convex sidewalls, and the flat top surface is greater than the flat bottom surface before connecting to other components.

37. A solder bump for interconnection of flip chip devices comprising:
a semiconductor surface;
at least one contact pad over said semiconductor surface;
a passivation layer over said semiconductor surface, said passivation layer exposing said at least one contact pad;
an Under-Bump-Metallurgy (UBM) layer over said passivation layer and said at least one contact pad, lateral dimension of the UBM layer being limited to a size approximately the same as lateral dimension of the at least one contact pad;
and

at least one solder compound overlying the UBM layer, wherein the solder compound comprises a flat top surface, a flat bottom surface and convex sidewalls, and the flat top surface is greater than the flat bottom surface before connecting to other components.

38. A solder bump for interconnection of flip chip devices comprising:
a semiconductor surface;
at least one contact pad over said semiconductor surface;
a passivation layer over said semiconductor surface, said passivation layer exposing said at least one contact pad;
an Under-Bump-Metallurgy (UBM) layer over said passivation layer and said at least one contact pad; and

at least one solder compound overlying the UBM layer, wherein the solder compound comprises a flat top surface, a flat bottom surface and convex sidewalls, and the flat top surface is greater than the flat bottom surface before connecting to other components.

Clearly, Marrs does not teach or suggest the claimed feature of “*at least one solder compound overlying the UBM layer*”. In fact, in col. 10, lines 20-31, Marrs specifically teaches away from this claimed feature by stating:

Several advantages result from the gold-to-gold or metal-to-metal bond 801 described above. First, gold is very ductile and malleable so it does not harden and crack. Also, the resulting weld is not as susceptible to melting as solder, which reflows at a relatively low temperature. This is a significant advantage over my U.S. Pat. No. 5,478,007 in which solder forms part of the electrical interconnection between the chip and substrate. *Further, as described above, there is no need for applying solder flux and therefore no added risk of*

corrosion of the aluminum bonding pads 204 and no need to clean off residual flux or inspect for residual flux.

(*Emphasis added.*) Therefore, according to this express teaching away of Marrs, those skilled in the art would not be motivated to form the coined ball bond bump 312 as expressly claimed by each of the independent claims of the present application.

For at least this reason, Applicant respectfully submits that Marrs is legally deficient for the purpose of anticipating claims 29 and 37-38, because at least the features/limitations emphasized above are not taught or otherwise disclosed by Marrs. As noted above, not only does Marrs fail to teach this expressly claimed feature, Marrs expressly teaches away from the claimed feature of “**solder compound overlying the UBM layer.**” Therefore, not only does Marrs fail to anticipate these claims, but Marrs likewise fails to render these independent claims obvious. For at least these reasons, Applicants respectfully assert that the amended claims 29 and 37-38 are in condition for allowance, and the Board should overturn the rejections.

As claim 31 is a dependent claim that incorporates the features/limitations of claim 29, Applicant respectfully asserts that this claim also is in condition for allowance. Likewise, as claims 30-34 and 36 are dependent claims that incorporate the features/limitations of claims 29, Applicant respectfully asserts that these claims also are in condition for allowance, and the Board should overturn the rejections.

35 U.S.C. 103(a)

The Office Action rejected claims 30, 32-34, and 36 under 35 U.S.C. 103(a) as allegedly unpatentable over Marrs (5,795,818) in view of Beddingfield (5,977,632). Applicants respectfully traverse the rejections.

As set forth above in the discussion of rejection under 35 U.S.C. 102(b), Applicants note that Marris does not teach or otherwise disclose the claimed feature of “*solder compound overlying the UBM layer.*” For at least this reason, Applicants respectfully assert that the combination of references is legally deficient for rendering these claims unpatentable.

Applicants respectfully assert that the cited references, either individually or in combination, are legally deficient for the purpose of rendering claims 30, 32-34, and 36 unpatentable. Specifically, Applicants respectfully assert that the references do not teach or reasonably suggest at least the features/limitations emphasized above in the base claims. For at least this reason, the rejections of these claims should be overturned.

As a separate and independent basis for traversing the 103 rejections, Applicants respectfully submit that the Office Action has failed to cite a proper motivation or suggestion for combining the cited references. In this regard, the *entire* rationale provided by the Office Action to allege because “Beddingfield discloses an analogous device” and that the combination of *Beddingfield* with *Marris* would have been obvious “so as to protect against the corrosion of the aluminum pads.” (Office Action, p. 5). These alleged motivations are improper.

First, the law requires a teaching, suggestion, or motivation to combine certain FEATURES which are claimed, not merely a reason to globally combine two references (which is all the FINAL Office Action sought to provide). If that were the case, then the Office Action would be free to mix and match features and components, from two distinct references, as will. The FINAL Office Action failed to cite ANY rationale or motivation for the combination with respect to the features embodied in claims 32, 33, 34, or 36. Therefore, the rejection is

fundamentally misplaced as to these claims. Furthermore, with respect to the rejection of claim 30, the alleged motivation of “so as to protect against the corrosion of the aluminum pads” is misplaced in that it is not relevant to the feature of claim 30. Moreover, the alleged motivation merely embodies a perceived (subjective) benefit that may result IF the combination was made. However, what the law requires is an objective teaching, from the prior art itself, that would lead one to make the specific combination of identifiable features. These alleged motivations are clearly improper in view of well-established Federal Circuit precedent.

It is well-settled law that in order to properly support an obviousness rejection under 35 U.S.C. § 103, there must have been some teaching in the prior art to suggest to one skilled in the art that the claimed invention would have been obvious. W. L. Gore & Associates, Inc. v. Garlock Thomas, Inc., 721 F.2d 1540, 1551 (Fed. Cir. 1983). More significantly,

"The consistent criteria for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that this [invention] should be carried out and would have a reasonable likelihood of success, viewed in light of the prior art. ..." Both the suggestion and the expectation of success must be founded in the prior art, not in the applicant's disclosure... In determining whether such a suggestion can fairly be gleaned from the prior art, the full field of the invention must be considered; for the person of ordinary skill in the art is charged with knowledge of the entire body of technological literature, including that which might lead away from the claimed invention."

(*Emphasis added.*) In re Dow Chemical Company, 837 F.2d 469, 473 (Fed. Cir. 1988).

In this regard, Applicants notes that there must not only be a suggestion to combine the functional or operational aspects of the combined references, but that the Federal Circuit also requires the prior art to suggest both the combination of elements and the structure resulting from the combination. Stiftung v. Renishaw PLC, 945 Fed.2d 1173 (Fed. Cir. 1991). Therefore, in order to sustain an obviousness rejection based upon a combination of any two or more prior art references,

the prior art must properly suggest the desirability of combining the particular elements to derive a device for improving the reliability of a flip-chip, as claimed by the Applicants.

When an obviousness determination is based on multiple prior art references, there must be a showing of some “teaching, suggestion, or reason” to combine the references. Gambro Lundia AB v. Baxter Healthcare Corp., 110 F.3d 1573, 1579, 42 USPQ2d 1378, 1383 (Fed. Cir. 1997) (also noting that the “absence of such a suggestion to combine is dispositive in an obviousness determination”).

Evidence of a suggestion, teaching, or motivation to combine prior art references may flow, inter alia, from the references themselves, the knowledge of one of ordinary skill in the art, or from the nature of the problem to be solved. See In re Dembiczak, 175 F.3d 994, 1000, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999). Although a reference need not expressly teach that the disclosure contained therein should be combined with another, the showing of combinability, in whatever form, must nevertheless be “clear and particular.” Dembiczak, 175 F.3d at 999, 50 USPQ2d at 1617.

If there was no motivation or suggestion to combine selective teachings from multiple prior art references, one of ordinary skill in the art would not have viewed the present invention as obvious. See In re Dance, 160 F.3d 1339, 1343, 48 USPQ2d 1635, 1637 (Fed. Cir. 1998); Gambro Lundia AB, 110 F.3d at 1579, 42 USPQ2d at 1383 (“The absence of such a suggestion to combine is dispositive in an obviousness determination.”).

Significantly, where there is no apparent disadvantage present in a particular prior art reference, then generally there can be no motivation to combine the teaching of another

reference with the particular prior art reference. Winner Int'l Royalty Corp. v. Wang, No 98-1553 (Fed. Cir. January 27, 2000).

Merely identifying some benefit (from hindsight) that results from a combination is not sufficient to justify the combination, and the motivation or suggestion must come from the prior art itself, and the Office Action has failed to identify such a motivation. As stated above, the Office Action stated only that the combination of *Beddingfield* with *Marrs* would have been obvious “to promote adhesion of the solder to the passivation layer and the pad (Office Action, p. 5). Similarly, the Office Action stated only that the combination of *Beddingfield* with *Marrs* would have been obvious “to protect against the corrosion of the aluminum pads.” These are not really even rationales at all. Instead, they appear only to be justifications based on the claimed utility (advanced with the benefit of hindsight). Under the approach adopted by the Office Action, it would always be possible to reject claims simply by relying on the utility of the claimed invention as providing the motivation to combine the cited references. Clearly, this approach is at odds with the well-established precedence of the Federal Circuit.

For at least the additional reason that the Office Action failed to identify proper motivations or suggestions for combining the various references to properly support the rejections under 35 U.S.C. § 103, those rejections should be overturned.

Comment on Finality of Office Action

As Applicant noted in its response filed July 1, 2006, the Office Action of April 24, 2006, was made FINAL on the grounds that Applicant’s previous amendments necessitated the new grounds of rejection. Applicant respectfully disagreed. In this regard, and taking claim 29 as a

representative claim, Applicant's previous amendment modified the last element of this claim as annotated below:

at least one solder compound overlying the UBM layer, wherein the solder compound comprises a flat top surface, a flat bottom surface and convex sidewalls ~~before connecting to other components, wherein, and~~ the flat top surface is greater than the flat bottom surface before connecting to other components.

As is readily verified, the amendment made only a cosmetic change to the claim, by essentially just moving a phrase within the claim element. Clearly, this amendment does not import a substantive distinction, which would necessitate further searching. Importantly, the "at least one solder compound overlying the UBM layer" feature, which (among other features) distinguishes the claims over the newly cited Marrs reference, has always been in the claims. Accordingly, Applicant respectfully submitted that the status of FINAL should have been withdrawn from the Office Action.

Notwithstanding this position, the Examiner mailed an Advisory Action on July 19, 2006. As noted above, this Advisory Action is based on a fundamental misapplication of a teaching in Marrs.

While the undersigned understands that the Finality of the FINAL Office Action is not an issue to be decided by the Board, the Board certainly may consider this as reflective of diligence in which the Examiner discharged his duties. That is, the Examiner has improperly made the Office Action FINAL, apparently in order to hastily end the prosecution of this application. This same haste appears to be embodied in the substance of the examination as well.

CONCLUSION

Based upon the foregoing discussion, Applicants respectfully requests that the Examiner's final rejection of claims 29-34 and 36-38 be overruled by the Board, and that the application be allowed to issue as a patent with all pending claims.

In addition to the claims of Appendix A, Appendix B attached hereto indicates that there is no evidence being submitted in connection with this Appeal Brief, and Appendix C attached hereto indicates that there are no related proceedings.

The \$500 fee for the Appeal Brief was previously submitted in connection with the original brief. There is believed to be no additional fee due in connection with this substitute brief. If, however, any additional fee is deemed to be payable, you are hereby authorized to charge any such fee to deposit account 20-0778.

Respectfully submitted,



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VIII. CLAIMS - APPENDIX

1-28. (Canceled)

29. A solder bump for interconnection of flip chip devices comprising:

a semiconductor surface;

at least one contact pad over said semiconductor surface;

a passivation layer over said semiconductor surface, said passivation layer exposing said at least one contact pad;

an Under-Bump-Metallurgy (UBM) layer over said layer of passivation and said at least one contact pad, lateral dimension of the UBM layer being limited to be within lateral dimension of the at least one contact pad; and

at least one solder compound overlying the UBM layer, wherein the solder compound comprises a flat top surface, a flat bottom surface and convex sidewalls, and the flat top surface is greater than the flat bottom surface before connecting to other components.

30. The solder bump of claim 29, said Under Bump Metallurgy layer comprising a layer of chromium followed by a layer of copper followed by a layer of gold.

31. The solder bump of claim 29, said Under Bump Metallurgy layer comprising a plurality of sub-layers of different metallic composition.

32. The solder bump of claim 29, said passivation layer comprising a plurality of passivation layers.

33. The solder bump of claim 32, wherein at least one of said plurality of passivation layers is PE Si_3N_4 , SiO_2 a photosensitive polyimide, phosphorous doped silicon dioxide or titanium nitride.

34. The solder bump of claim 29, said at least one contact pad on said semiconductor surface being electrically connected with a semiconductor device with at least one conductive line of interconnect or with at least one conductive contact point.

35. (Cancelled)

36. The solder bump of claim 29, further comprising a seed layer having been deposited over said patterned layer of passivation.

37. A solder bump for interconnection of flip chip devices comprising:

- a semiconductor surface;
- at least one contact pad over said semiconductor surface;
- a passivation layer over said semiconductor surface, said passivation layer exposing said at least one contact pad;
- an Under-Bump-Metallurgy (UBM) layer over said passivation layer and said at least one contact pad, lateral dimension of the UBM layer being limited to a size approximately the same as lateral dimension of the at least one contact pad; and

at least one solder compound overlying the UBM layer, wherein the solder compound comprises a flat top surface, a flat bottom surface and convex sidewalls, and the flat top surface is greater than the flat bottom surface before connecting to other components.

38. A solder bump for interconnection of flip chip devices comprising:

a semiconductor surface;

at least one contact pad over said semiconductor surface;

a passivation layer over said semiconductor surface, said passivation layer exposing said at least one contact pad;

an Under-Bump-Metallurgy (UBM) layer over said passivation layer and said at least one contact pad; and

at least one solder compound overlying the UBM layer, wherein the solder compound comprises a flat top surface, a flat bottom surface and convex sidewalls, and the flat top surface is greater than the flat bottom surface before connecting to other components.

IX. EVIDENCE - APPENDIX

None.

IX. RELATED PROCEEDINGS- APPENDIX

None.